

Claims

1. A method of estimating a timing of a first transmission received with a second transmission as a combined signal over a multiple access interference channel, comprising:
 - 5 a. estimating the timing of the second transmission;
 - b. demodulating, decoding and remodulating the second transmission, on the basis of the estimated timing of the second transmission, to generate an estimate of the second transmission;
 - 10 c. cancelling the estimate of the second transmission from the combined signal to generate an estimate of the first transmission; and
 - d. estimating the timing of the first transmission from the estimate of the first transmission.
2. The method of claim 1, wherein the cancelling of the estimate of the second transmission is weighted according to the probability of the estimate.
3. The method of claim 2, wherein the probability of the estimate is calculated using a soft decoding technique to decode the second transmission.
4. The method of claim 2 or 3, wherein the probability of the estimate is calculated using a soft demodulating technique to demodulate the second transmission.
- 20 5. The method of any one of claims 1 to 4, further including:
 - e. demodulating, decoding and remodulating the first transmission, on the basis of the estimated timing of the first transmission, to generate an estimate of the first transmission;
 - 25 f. cancelling the estimate of the first transmission from the combined signal to generate an estimate of the second transmission; and

- g. estimating the timing of the second transmission from the estimate of the second transmission.
6. The method of claim 5, including repeating steps b to g so as to obtain improved estimates of the timings of the first and second transmissions.
- 5 7. The method of any preceding claim, wherein the combined signal includes one or more further transmissions.
8. The method of claim 7, wherein step a includes estimating the timing of the one or more further transmissions, step b includes demodulating, decoding and remodulating the one or more further transmissions, on the basis of the
10 respective estimated timing of the one or more further transmissions, to generate an estimate of the one or more further transmissions, and step c includes cancelling the estimate of the one or more further transmissions from the combined signal to generate an estimate of the first transmission.
9. The method of claim 8 when dependent on claim 5, wherein step f includes
15 cancelling the estimate of the one or more further transmissions from the combined signal to generate the estimate of the second transmission.
10. A method of estimating the timings of a plurality of transmissions received as a combined signal over a multiple access channel, comprising:
- a. estimating the timings of each of the plurality of transmissions;
- 20 b. soft demodulating, soft decoding and soft remodulating current estimates of each of the plurality of transmissions, on the basis of their respective estimated timings, to generate soft estimates of each of the transmissions;
- c. updating the current estimates of each of the transmissions by
25 cancelling the soft estimates of the other transmissions from the combined signal;
- d. estimating the timings of each of the transmissions from the respective current estimates of the transmissions; and

- e. repeating steps b to e to obtain progressive estimates of the timings of each of the transmissions.

11. The method of claim 10, wherein steps a to e are repeated until a predetermined condition is satisfied.

5 12. The method of claim 11, including outputting the soft decoded current estimates.

13. The method of any preceding claim, wherein the timing estimating steps are performed using differential detection.

10 14. The method of any preceding claim, wherein the timing estimating steps are performed using coherent detection.

15. A computer program for performing the method of any preceding claim when executed.

16. A computer program product storing a computer program according to claim 15.

15 17. Apparatus for estimating a timing of a first transmission received with a second transmission as a combined signal over a multiple access interference channel, the apparatus being arranged to:

- a. estimate the timing of the second transmission;
- 20 b. demodulate, decode and remodulate the second transmission, on the basis of the estimated timing of the second transmission, to generate an estimate of the second transmission;
- c. cancel the estimate of the second transmission from the combined signal to generate an estimate of the first transmission; and
- 25 d. estimate the timing of the first transmission from the estimate of the first transmission.

18. The apparatus of claim 17, wherein the cancelling of the estimate of the second transmission is weighted according to the probability of the estimate.
19. The apparatus of claim 18, wherein the probability of the estimate is calculated using a soft decoding technique to decode the second transmission.
- 5 20. The apparatus of claim 17 or 18, wherein the probability of the estimate is calculated using a soft demodulating technique to demodulate the second transmission.
21. The apparatus of any one of claims 17 to 20, further arranged to:
- 10 e. demodulate, decode and remodulate the first transmission, on the basis of the estimated timing of the first transmission, to generate an estimate of the first transmission;
 - f. cancel the estimate of the first transmission from the combined signal to generate an estimate of the second transmission; and
 - 15 g. estimate the timing of the second transmission from the estimate of the second transmission.
22. The apparatus of claim 21, further arranged to repeat steps b to g so as to obtain improved estimates of the timings of the first and second transmissions.
23. The apparatus of any one of claims 17 to 22, wherein the combined signal includes one or more further transmissions.
- 20 24. The apparatus of claim 23, wherein step a includes estimating the timing of the one or more further transmissions, step b includes demodulating, decoding and remodulating the one or more further transmissions, on the basis of the respective estimated timing of the one or more further transmissions, to generate an estimate of the one or more further transmissions, and step c
- 25 includes cancelling the estimate of the one or more further transmissions from the combined signal to generate an estimate of the first transmission.

25. The method of claim 24 when dependent on claim 21, wherein step f includes cancelling the estimate of the one or more further transmissions from the combined signal to generate the estimate of the second transmission.
- 5 26. Apparatus for estimating the timings of a plurality of transmissions received as a combined signal over a multiple access channel, the apparatus being arranged to:
- a. estimate the timings of each of the plurality of transmissions;
 - b. soft demodulate, soft decode and soft remodulate current estimates of each of the plurality of transmissions, on the basis of their
10 respective estimated timings, to generate soft estimates of each of the transmissions;
 - c. update the current estimates of each of the transmissions by cancelling the soft estimates of the other transmissions from the combined signal;
 - d. estimate the timings of each of the transmissions from the respective
15 current estimates of the transmissions; and
 - e. repeat steps b to e to obtain progressive estimates of the timings of each of the transmissions.
- 20 27. The apparatus of claim 26, wherein steps a to e are repeated until a predetermined condition is satisfied.
28. The apparatus of claim 27, including outputting the soft decoded current estimates.
29. The apparatus of any one of claims 17 to 28, wherein the timing estimating steps are performed using differential detection.
- 25 30. The apparatus of any one of claims 17 to 29, wherein the timing estimating steps are performed using coherent detection.